# COSEWIC
# Assessment and Status Report

on the

# Wood Thrush
*Hylocichla mustelina*

**in Canada**

**THREATENED**
**2012**

**COSEWIC**
Committee on the Status
of Endangered Wildlife
in Canada

**COSEPAC**
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC. 2012. COSEWIC assessment and status report on the Wood Thrush *Hylocichla mustelina* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 46 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

Production note:
COSEWIC would like to acknowledge Carl Savignac for writing the status report on the Wood Thrush, *Hylocichla mustelina*, in Canada, prepared under contract with Environment Canada. The report was overseen and edited by Marty Leonard, COSEWIC Birds Specialist Subcommittee Co-chair.

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur la Grive des bois (*Hylocichla mustelina*) au Canada.

Cover illustration/photo:
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Catalogue No. CW69-14/664-2013E-PDF
ISBN 978-1-100-22137-3

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# COSEWIC
# Assessment Summary

**Assessment Summary – November 2012**

**Common name**
Wood Thrush

**Scientific name**
*Hylocichla mustelina*

**Status**
Threatened

**Reason for designation**
In Canada, this forest–nesting species has shown significant long- and short-term declines in population abundance. The species is threatened by habitat loss on its wintering grounds and habitat fragmentation and degradation on its breeding grounds. It also suffers from high rates of nest predation and cowbird parasitism associated with habitat fragmentation on the breeding grounds.

**Occurrence**
Ontario, Quebec, New Brunswick, Nova Scotia

**Status history**
Designated Threatened in November 2012.

**COSEWIC**
**Executive Summary**

# Wood Thrush
*Hylocichla mustelina*

## Wildlife Species Description and Significance

The Wood Thrush is a medium-sized Neotropical migrant, slightly smaller than the American Robin. Sexes are similar; adults are generally rusty-brown on the upperparts with white underparts and large blackish spots on the breast and flanks. Juveniles are similar to adults, but have tawny streaks and spots on the back, neck, and wing coverts. Overall, the plumage is quite distinctive and the Wood Thrush is not likely to be confused with other thrush species or the Brown Thrasher. The Wood Thrush has become a symbol of declining Neotropical migrants due to significant declines over much of its range since the late 1970s.

## Distribution

The Wood Thrush breeds in southeastern Canada from southern Ontario east to Nova Scotia. It also nests across the eastern United States, south to northern Florida and the Gulf Coast. In the west, it ranges from eastern Texas to southeast South Dakota and west-central Minnesota. Wood Thrushes winter in Central America mainly in lowland and tropical forests along the Atlantic and the Pacific slopes from southern Mexico south to Panama.

## Habitat

In Canada, the Wood Thrush nests mainly in second-growth and mature deciduous and mixed forests, with saplings and well-developed understory layers. This species prefers large forest mosaics, but may also nest in small forest fragments.

Wintering habitat is characterized primarily by undisturbed to moderately disturbed wet primary lowland forests.

## Biology

The Wood Thrush is typically socially monogamous, but does engage in extra-pair matings. In Canada, most breeding adults arrive on the breeding grounds from mid-late May. Nests are located in living saplings, trees or shrubs, usually in Sugar Maple or American Beech. Clutches contain an average of 4 eggs and double brooding is frequent. Incubation lasts 10-12 days; young are tended by both parents and fledge after 12–15 days. Fledglings remain on their natal home range for 24-33 days before departing to the wintering range between mid-August and mid-September. Age of first reproduction for the Wood Thrush is one year.

## Population Sizes and Trends

The Canadian population of Wood Thrush is estimated at between 260,000 and 665,000 mature individuals.

Breeding Bird Survey (BBS) results show a significant annual rate of decline of 4.29% between 1970 and 2011, which amounts to a population loss of 83% over the last 41 years. Over the most recent 10-year period (2001 to 2011) and approximately three generations, BBS data show a significant decline of 4.69% per year amounting to a loss of 38% of the population over this period.

## Threats and Limiting Factors

Several threats are currently known to affect the Wood Thrush. On the breeding grounds the main threats include habitat degradation and fragmentation due to development and over-browsing by White-tailed Deer. High rates of nest predation and Brown-headed Cowbird nest parasitism associated with habitat fragmentation also threaten the Wood Thrush. On the wintering grounds the main threats are habitat loss and degradation.

## Protection, Status, and Ranks

In Canada, the Wood Thrush and its nests and eggs are protected under the *Migratory Birds Convention Act*. In Québec, it is also protected under the *Loi sur la conservation et la mise en valeur de la faune*. General Status ranks for Wood Thrush consider the species secure in Canada, Ontario and Québec, may be at risk in New Brunswick, and undetermined in Nova Scotia.

## TECHNICAL SUMMARY

*Hylocichla mustelina*
Wood Thrush Grive des bois
Range of Occurrence in Canada: Ontario, Québec, New Brunswick, Nova Scotia

**Demographic Information**

| | |
|---|---|
| Generation time | 2 to 3 yrs |
| Is there an [observed, inferred, or projected] continuing decline in number of mature individuals? | Yes, observed |
| Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations] | N/A |
| [Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].<br><br>- Long-term Breeding Bird Survey data show a significant annual rate of decline of 4.29% between 1970 and 2011 for a population loss of 83% over the last 41 years. Data from the most recent 10-year period (2001 - 2011) show a significant decline of 4.69% per year for a 38% reduction in the total number of mature individuals over the last 10 years. The probability of a decline of at least 30% over this period is 89%. | 38% reduction |
| [Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next 10 years, or 3 generations]. | Unknown, but long-term decline expected to continue |
| [Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future. | Unknown, but long-term decline expected to continue |
| Are the causes of the decline clearly reversible and understood and ceased? | No. Not likely reversible; not well understood and not likely ceased |
| Are there extreme fluctuations in number of mature individuals? | No |

**Extent and Occupancy Information**

| | |
|---|---|
| Estimated extent of occurrence<br><br>- Based on a minimum convex polygon of the species range map provided in Figure 3 | 978,000 $km^2$ |
| Index of area of occupancy (IAO)<br><br>- Based on 2X2 km grid | > 2,000 $km^2$ |
| Is the total population severely fragmented? | No |
| Number of "locations" | Unknown |
| Is there an [observed, inferred, or projected] continuing decline in extent of occurrence? | No |
| Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?<br><br>- Breeding bird atlas data indicate a decrease in occupancy | Yes |

| | |
|---|---|
| Is there an [observed, inferred, or projected] continuing decline in number of populations?<br><br>- Subpopulation structure is unknown | Unknown |
| Is there an [observed, inferred, or projected] continuing decline in number of locations*? | Number of locations is not known |
| Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat? | Yes |
| Are there extreme fluctuations in number of populations? | No |
| Are there extreme fluctuations in number of locations? | No |
| Are there extreme fluctuations in extent of occurrence? | No |
| Are there extreme fluctuations in index of area of occupancy? | No |

**Number of mature individuals in each population**

| Population | N Mature Individuals |
|---|---|
| Crude estimate ranging between 260,000 (Blancher and Couturier 2007) based on an extrapolation from the Ontario Breeding Bird Atlas and 665,000 based on the Breeding Bird Survey (P. Blancher upublished data 2012) | 260,000 - 665,000 |
| | |
| Total | |

**Quantitative Analysis**

| | |
|---|---|
| Ex.: % chance of extinction in 50 years | Not done |

**Threats (actual or imminent, to populations or habitats)**

- Habitat fragmentation and degradation on the breeding grounds, habitat loss on wintering grounds
- High rates of nest predation and cowbird parasitism linked to habitat fragmentation on the breeding ground

**Rescue Effect (immigration from an outside source)**

| | |
|---|---|
| Status of outside population(s)?<br><br>USA: Overall, significant decline of 1.8% per year (1966-2010; Sauer *et al.* 2011), with significant declines reported for many northeastern states near the Canadian border | |
| Is immigration known or possible? | Yes |
| Would immigrants be adapted to survive in Canada? | Yes |
| Is there sufficient habitat for immigrants in Canada? | Yes |
| Is rescue from outside populations likely? | Possible, but increasingly tempered by declines in the northeastern US, especially in states bordering Canada |

**Current Status**

| |
|---|
| COSEWIC: not assessed previously |

**Status and Reasons for Designation**

| **Status:** | **Alpha-numeric code:** |
|---|---|
| Threatened | A2b |
| **Reasons for designation:**<br>In Canada, this forest-nesting species has shown significant long- and short-term declines in population abundance. The species is threatened by habitat loss on its wintering grounds and habitat fragmentation and degradation on its breeding grounds. It also suffers from high rates of nest predation and cowbird parasitism associated with habitat fragmentation on the breeding grounds. | |

**Applicability of Criteria**

| |
|---|
| **Criterion A** (Decline in Total Number of Mature Individuals):<br>Meets Threatened A2b because the population has declined by more than 30% over the last 10 years (approximately three generations) based on an appropriate index of abundance (b). |
| **Criterion B** (Small Distribution Range and Decline or Fluctuation):<br>Does not meet criterion, range exceeds thresholds. |
| **Criterion C** (Small and Declining Number of Mature Individuals):<br>Does not meet criterion, population size exceeds thresholds. |
| **Criterion D** (Very Small or Restricted Total Population):<br>Does not meet criterion, both population and distribution exceed thresholds. |
| **Criterion E** (Quantitative Analysis): Not done |

## COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

## COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

## COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

## DEFINITIONS
## (2012)

| | |
|---|---|
| Wildlife Species | A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years. |
| Extinct (X) | A wildlife species that no longer exists. |
| Extirpated (XT) | A wildlife species no longer existing in the wild in Canada, but occurring elsewhere. |
| Endangered (E) | A wildlife species facing imminent extirpation or extinction. |
| Threatened (T) | A wildlife species likely to become endangered if limiting factors are not reversed. |
| Special Concern (SC)* | A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats. |
| Not at Risk (NAR)** | A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances. |
| Data Deficient (DD)*** | A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction. |

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment Canada / Environnement Canada
Canadian Wildlife Service / Service canadien de la faune
Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

# COSEWIC Status Report

on the

# Wood Thrush

*Hylocichla mustelina*

**in Canada**

2012

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## WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

### Name and Classification

*Hylocichla mustelina* (J. F. Gmelin, 1789) is commonly called the Wood Thrush. The French name is '*Grive des bois*'. The taxonomy is as follows:

Class: Aves
Order: Passeriformes
Family: Turdidae
Genus: *Hylocichla*
Species: Hylocichla mustelina

### Morphological Description

The Wood Thrush is a medium-sized bird (19–21 cm, 40–50 g) similar in shape and posture to the American Robin (*Turdus migratorius*) and other thrush species (Evans *et al.* 2011). Both sexes have similar plumage. Adults have rusty-brown on the crown and nape, fading to olive-brown on back, wings, and tail. Underparts are white with conspicuous large blackish spots on the breast, sides, and flanks. Adults also have dull white eye-rings and the bill is buff-colored at the base, but darkening to dark brown on the upper mandible and tip (Figure 1). The legs are pinkish. The juvenile plumage is similar to the adult but with tawny streaks and spots on the back, neck, and wing coverts (Evans *et al.* 2011).

Adult Wood Thrushes can be distinguished from other Canadian thrushes by their rusty head and large blackish spots contrasting with white underparts. The species could perhaps be confused with the Brown Thrasher (*Toxostoma rufum*), which has a longer tail, a longer straighter bill, black-streaked underparts and a pale eye and uses shrubby habitat instead of second-growth and mature forest (Evans *et al.* 2011).

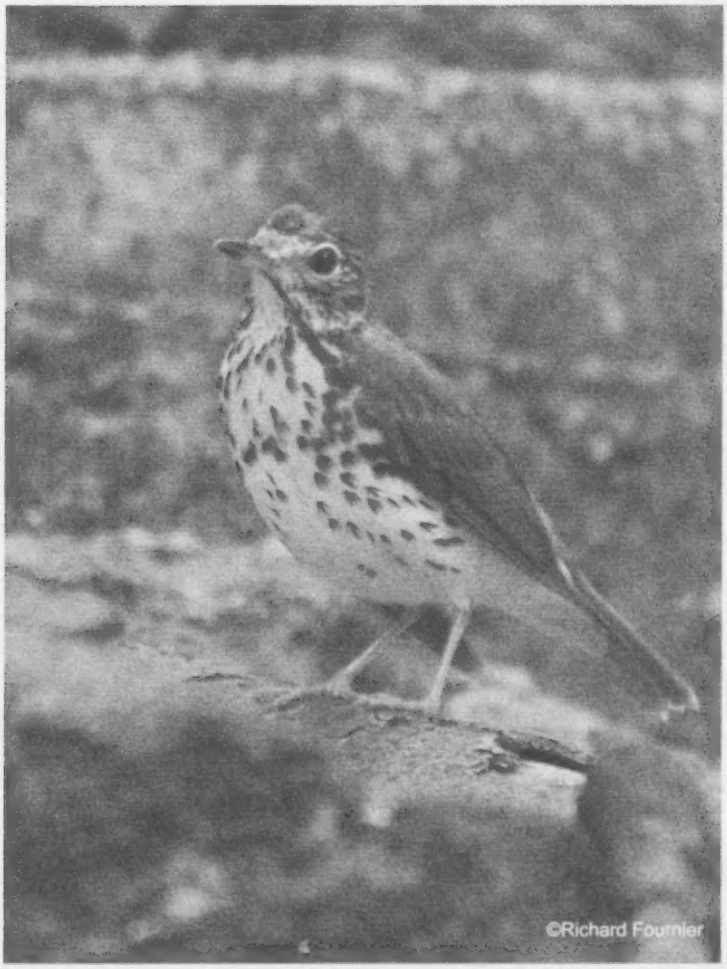


Figure 1. Adult Wood Thrush (Photo by Richard Fournier with permission)

## Population Spatial Structure and Variability

No research has been conducted on the population genetics or spatial structure of the Wood Thrush (Evans *et al.* 2011). There is a clinal decrease in the extent of rufous colour on the back and in body size from north to south in North America (Browning 1978).

## Designatable Units

No subspecies have been recognized for the Wood Thrush (Browning 1978; American Ornithologists' Union [AOU] 1998) and there are no other distinctions that warrant assessment below the species level. This report deals with a single designatable unit.

### Special Significance

The Wood Thrush has become a symbol of declining Neotropical migrants. Its conspicuous song, widespread occurrence in a variety of wooded habitats, and vulnerability both to parasitism by the Brown-headed Cowbird (*Molothrus ater*) and to some degree to forest fragmentation make it a frequent subject of ecological research (Evans *et al.* 2011).

There is no available Aboriginal traditional knowledge known at this time that is pertinent to the status assessment of the Wood Thrush.

## DISTRIBUTION

### Global Range

The North American breeding range of the Wood Thrush extends generally from New Brunswick and southwestern Nova Scotia (Bird Studies Canada [BSC] 2012a), southern Québec (Cyr and Larivée 1995; Gauthier and Aubry 1995), southern Ontario (Friesen 2007), southern Manitoba (occasional visitor; Carey *et al.* 2003) and northern Minnesota (Janssen 1987) south to northern Florida (Robertson and Woolfenden 1992) and the Gulf Coast. In the west, it ranges from eastern Texas to southeast South Dakota and west-central Minnesota (Janssen 1987; Evans *et al.* 2011; Figure 2). Reports of isolated nesting and unpaired individuals extend north to north-central Minnesota, eastern North Dakota, and west to west-central Oklahoma and Kansas (Evans *et al.* 2011; Figure 2).

The Wood Thrush winters in Central America, mainly in lowlands along the Atlantic and the Pacific slopes from southern Mexico south to Panama (Figure 2; Ridgely and Gwynne 1989; Stiles and Skutch 1989; AOU 1998; Evans *et al.* 2011). The species is occasional to very rare in winter in the southeastern United States (e.g., Florida; Stevenson and Anderson 1994), western Caribbean, northwest Mexico (Howell and Webb 1995), and northern South America (Ridgely and Tudor 1989).

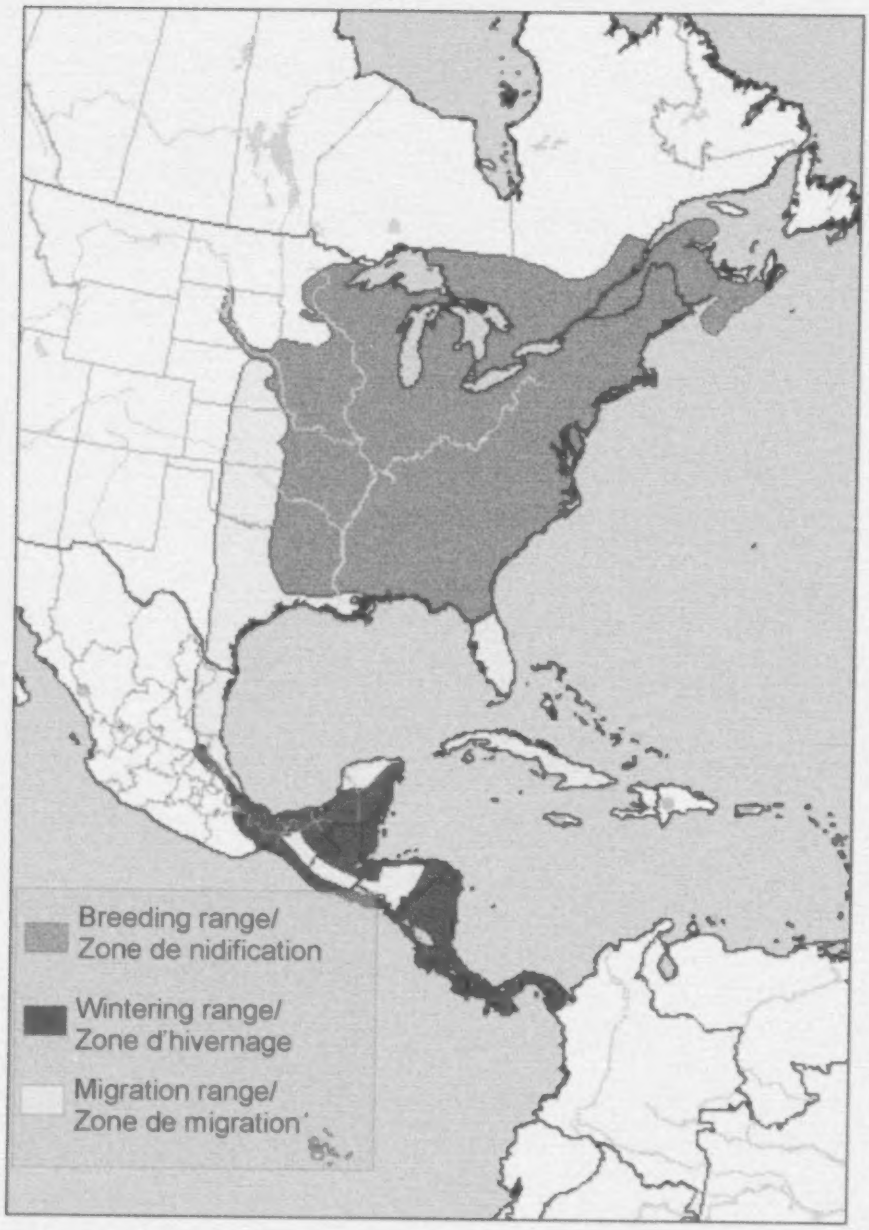


Figure 2. Global range of the Wood Thrush (modified from Ridgely *et al.* 2003).

Figure 3. Current Canadian breeding range of the Wood Thrush (based on Gauthier and Aubry 1995; Friesen 2007; BSC 2012a,b, Ebird 2012). The species is considered an occasional visitor to Manitoba (Carey *et al.* 2003).

## Canadian Range

The Wood Thrush breeds in southeastern Canada including Ontario, Québec, New Brunswick and Nova Scotia (Figure 3; Godfrey 1986; Evans *et al.* 2011). More specifically, its breeding range extends throughout southern Ontario north continuously to northern Georgian Bay and eastern Lake Superior, and locally northward to Timiskaming District. An isolated breeding population exists in Great Lakes-St. Lawrence Forest in western Rainy River District. In Québec, it nests in most of the St. Lawrence Valley Lowlands north to Saguenay-Lac-St-Jean and Gaspé, and also in the Laurentian, Outaouais and Abitibi and Temiscamingue regions and possibly on the Magdalen Islands (Gauthier and Aubry 1995). Wood Thrushes nest throughout New Brunswick and Nova Scotia, except for Cape Breton Island (BSC 2012a). Reports of isolated nesting and unpaired individuals extend north to southern Cape Breton Island, northern New Brunswick (Erskine 1992), and southern Manitoba (Carey *et al.* 2003; BSC 2012b).

The extent of occurrence (EO) in Canada is 978,000 $km^2$, as measured by a minimum convex polygon based on Figure 3. The biological area of occupancy (BAO) in Canada is estimated at 9,260 $km^2$ based on: 1) an estimated 463,000 individuals or

231,500 breeding pairs, the midpoint between the range of population estimates (see Population Size and Trends section) and 2) an average territory size of 4 ha (Evans *et al.* 2008). The estimated index of area of occupancy (IAO) based on a 2 km x 2 km grid intersecting known areas of occupancy for the species cannot be calculated due to a lack of detailed information on the occurrence of breeding sites, but it undoubtedly exceeds COSEWIC's minimum threshold of 2,000 $km^2$.

According to the Ontario and Maritime Breeding Bird Atlases, the EO has probably not changed significantly over the last 20 years (Cadman *et al.* 2007; BSC 2012a). The IAO, however, appears to have decreased between the first and second atlas periods, especially in the southern Shield region in Ontario and throughout New Brunswick (Cadman *et al.* 2007; BSC 2012a).

### Search Effort

Distributional data for Wood Thrush in Canada mainly come from breeding bird atlases conducted from 1981-1985 and 2001-2005 in Ontario (Cadman *et al.* 2007), Québec (1984-1989; Gauthier and Aubry 1995), and the Maritimes (2006-2010; Erskine 1992; BSC 2012a). Distributional data are also provided by published summaries of historical observations from checklists in Québec (Cyr and Larivée 1995) and Nova Scotia (Tufts 1986). The abundance data map from the BBS also provides useful insight into the species' distribution in Canada (Environment Canada 2009).

## HABITAT

### Habitat Requirements

During the breeding season, the Wood Thrush is found in moist, deciduous hardwood or mixed stands, often previously disturbed (e.g., small-scale logging and ice storm damage), with a dense deciduous undergrowth and with tall trees for singing perches (Gauthier and Aubry 1995; Friesen *et al.* 1999; Holmes and Sherry 2001; Friesen 2007; Evans *et al.* 2011; Suarez-Rubio *et al.* 2011). Peck and James (1987) found that in Ontario, the Wood Thrush prefers second-growth over mature forests. In southern Québec, the species is mainly associated with mature Sugar Maple (*Acer saccharum*)-dominated stands (Gauthier and Aubry 1995) but also is found in American Beech (*Fagus grandifolia*) stands of moderate density, where soil conditions are either mesic or xeric (Ouellet 1974).

Wood Thrushes choose habitats based on the structure of the forest (Evans *et al.* 2011). Specifically, this species selects nesting sites with the following characteristics: lower elevations with trees >16 m in height, a closed canopy cover (>70 %), a high variety of deciduous tree species, moderate subcanopy and shrub density, shade, fairly open forest floor, moist soil, and decaying leaf litter (Roth 1987; Robbins *et al.* 1989; Evans *et al.* 2011).

This species prefers nesting in large forest mosaics (Weinberg and Roth 1998), but will also use highly fragmented forests (Evans *et al.* 2011). In southern Québec, the Wood Thrush was associated with higher densities of large diameter trees (Carignan 2006). At the local scale, it was also correlated with higher understory vegetation cover, and at the woodlot scale there were indications of a negative association with the perimeter/area ratio of forest stands (Carignan 2006).

Wintering habitat is characterized primarily by undisturbed to moderately disturbed wet primary tropical forests. Preferred habitat includes interior understory of tropical primary, closed-canopy, semi-evergreen, broad-leaved, and mixed palm forests at 50-1000 m elevation from humid lowland to arid or humid mountain forest, as well as scrub and thickets (Rappole *et al.* 1989; Winker *et al.* 1990; Blake and Loiselle 1992; Petit *et al.* 1992; Powell *et al.* 1992). In Costa Rica, the Wood Thrush is found exclusively in forest in the Atlantic lowlands in sites with open understory in primary forest and with well-developed understory in old second growth (Evans *et al.* 2011; Roberts 2011). In contrast, in southern Veracruz, Mexico, areas with gaps are preferred in the lowland rainforest as well as areas with heavy ground cover (Winker *et al.* 1990). In Costa Rica, the Wood Thrush occupied all surveyed forest fragments that were ≥1 ha with mean densities highest in large, contiguous forests (Roberts 2011).

**Habitat Trends**

Breeding grounds

Historically, Wood Thrush habitat in eastern Canada, notably older deciduous and mixed forests, has been greatly reduced by large-scale clearing by European settlers for the development of agriculture and urbanization (Ouellet 1974; Keddy 1994; Li and Ducruc 1999; Gratton 2010). In southern Québec, several regions along the St. Lawrence River have experienced a high rate of deforestation for intensive agriculture such as the Montérégie region where less than 30% forest cover is currently left (Gauthier and Aubry 1995). In eastern Ontario, only 20-30% of the original deciduous forest remained by the 1880s, largely due to European settlement and the logging industry (Keddy 1994; OMNR 1997; Larson *et al.* 1999). Since 1920, there have been further losses in the amount of original forest of southern Ontario, but this has been offset by a dramatic increase in second-growth forests on abandoned agricultural land (Larson *et al.* 1999). In the Atlantic Maritime Ecozone, the relative coverage of rich hardwood forests has been historically small. Since human settlement it has been greatly reduced in area and highly fragmented, mainly due to clearing for agriculture and urban development, high-grading, introduced diseases, and flooding for power production (Loo *et al.* 2010).

The total forest cover in southern Ontario increased to about 19% by 1986, but most of this consisted of second-growth forest and the extent of original forest declined to only 5.8% of total land cover (Larson *et al.* 1999). By the end of the 1990s, the average overall forest cover in eastern Ontario was expected to level out at approximately 40% (OMNR 1997). In the St. Lawrence lowland of Québec, by the end

of the 1990s an important area of old fields and young forests had been converted into mature forests (Latendresse *et al.* 2008), a generally less suitable habitat for Wood Thrush due to its homogeneity and the lack of forest clearings supporting a well-developed understory (Ahlering and Faaborg 2006; Friesen pers. comm. 2012). Removal of understory to favour the growth of Sugar Maple stands may reduce the suitability of habitat for Wood Thrush (Carignan pers. comm. 2012). The extent of even-aged forests that lack a well-developed understory in Ontario and Quebec is, however, not known. Between the 1980s and the 2000s in New Brunswick, the area of forest habitat that is suitable for Wood Thrushes has shown declines of 23% for older tolerant hard wood forest and 72% for older mixed wood forest (New Brunswick Department of Natural Resources unpublished data 2012). These estimates exclude large industrial freeholds, which have experienced high timber harvest rates.

Wintering grounds

The Central American humid lowlands where the Wood Thrush overwinters has shown the fastest rate of deforestation in the Americas since the 1940s (Terborg 1989; Roberts 2011). In Costa Rica, for example, the lowland forests alone have declined by 9% per year for a loss of 78% since the 1970s (Sader and Joyce 1988). This habitat loss is also accompanied by an increase in the number of forest fragments, many of which are small (i.e. 0.03-0.50 $km^2$, Sánchez-Azofeifa *et al.* 2001).

Deforestation rates for Central America indicate losses of 0.80-1.5% per year as a percentage of the 1990 cover rate (Achard *et al.* 2002). As of 1998, only 20% of the region consisted of dense forest and much of what remained was fragmented or likely to be converted to agricultural land (CCAD 1998 cited in Harvey *et al.* 2004). Recent estimates by a 2007 intergovernmental panel on climate change (IPCC) working group indicated that by 2010, forested areas of Central America would be reduced by another 1.2 Mha (IPCC 2007), suggesting that the high rate of deforestation in the wintering grounds of this species is ongoing.

## BIOLOGY

Some studies have been conducted on the Wood Thrush in Canada, but the number is low compared to the United States. The research conducted by Lyle Friesen on nesting success, population viability, pairing success, nest reuse, response to urban development, return rates, cowbirds, and extra-pair mating is particularly important in Ontario. For a review of the species ecology in North America see Evans *et al.* (2011).

### Reproduction

The Wood Thrush is typically socially monogamous, but does show extra-pair mating (Evans *et al.* 2009). There is some evidence of occasional polygyny (Johnson *et al.* 1991).

In Canada, males arrive on the breeding grounds between the first week of April and the second week of June (BSC 2011), but in the core of the breeding range (i.e. Ontario), most breeding adults arrive from mid-May to the end of May (Friesen, pers. comm. 2012). Some males arrive and establish territories several days before the earliest females (Evans *et al.* 2011). Copulation may start as early as 1-3 days after the male's arrival (Weaver 1949; Brackbill 1958). In Ontario, nests are usually located in living saplings, trees or shrubs and on top of dead stumps, usually in Sugar Maple, American Beech, and English Hawthorn (*Crataegus monogyna*) (Peck and James 1987). In Ontario, Red-berried Elder (*Sambucus racemosa*) is an important nesting shrub for Wood Thrushes, particularly in early spring because it is one of the first shrubs/trees to leaf out and thus provides concealment for nests (Friesen, pers. comm. 2012).

In Ontario, clutches consist of 1-5 eggs (average of 4 eggs, n=61 nests; Peck and James 1987). At the beginning of the breeding season, clutches average 3-4 eggs, but average 2-3 eggs later in the season (Friesen, pers. comm. 2012).

Double brooding is frequent in Wood Thrushes (Evans *et al.* 2011) and triple brooding has also been observed in southern Ontario and in northwest Pennsylvania, where all three nests fledged young (Friesen *et al.* 2001; Gow 2009). Rates of double brooding vary from 74% to 87% of females in southern Ontario (Friesen *et al.* 2001). In southern Québec, double brooding is known to be infrequent (Carignan, pers. comm. 2012). Eggs generally hatch 12 days after the last egg is laid (Evans *et al.* 2011; Friesen, pers. comm. 2012). The young are tended by both parents and fledge at 12-15 days (Brackbill 1943). In Georgia and in Missouri, fledglings remain on their natal home range from 24-33 days on average (Vega Rivera *et al.* 1998; Lang *et al.* 2002). Peak fall departure for migrants in Ontario occurs from mid-August to mid-September, but departures continue until mid-November (BSC 2011).

Long-term data derived from nearly 750 Wood Thrush nests monitored from 1998 to 2010 in Waterloo, Ontario showed an average of 1.4 fledglings/nest and 2.7 nestlings fledged per successful nest. These values are relatively high compared to other studies in the eastern US where breeding habitat is highly fragmented by agriculture (L. Friesen; unpubl. data 2012).

Daily nest survival for the Wood Thrush in the eastern US is fairly high ranging between 92% and 97% (Simons *et al.* 2000; Sargent *et al.* 2003; Gow 2009). The Mayfield seasonal nest survival value varies between 14%-29% in fragmented landscapes and 30%-50% in forested habitat (Powell *et al.* 1999; Robinson *et al.* 1995; Burke and Nol 2000). Fauth (2000) reported Mayfield survival rates in fragmented forests in northern Indiana from 16% to 71%. In Ontario's Waterloo Region, Mayfield estimates varied between 47% and 54% for Wood Thrushes between 1998 and 2010 suggesting that this population is self-sustaining (L. Friesen; unpubl. data 2012). From these latter data, it appears that reproductive success in Wood Thrushes in southern Ontario can be relatively high even in small forest fragments (Friesen *et al.* 1999).

Age of first reproduction is one year (Evans *et al.* 2011). Generation time for the Wood Thrush, which corresponds to the average breeding age, is estimated at 2-3 years.

**Survival**

The oldest known individual based on banding records is 8 years and 11 months (Klimkiewicz *et al.* 1983). Life expectancy for this species is probably around 5 years (Evans *et al.* 2011).

Based on adult return rates to breeding territories, annual survival rates for the Wood Thrush are estimated at about 70% for males and 75% for females, while apparent annual return is estimated at 58% (Powell *et al.* 2000). Friesen *et al.* (2005) reported a 59% return rate for females at a large forest in Waterloo Region, compared to 31% for males. Combining all sites in that study from 1999 to 2009 shows annual return rates of 12% to 41% for females and 28% to 50% for males (L. Friesen, unpubl. data 2012).

The time-constant annual apparent survival rate (which is defined as the probability that an individual survives and remains in the sampled population) from the Monitoring Avian Productivity and Survivorship (MAPS) program over the entire species range between 1992 and 2001 is estimated at 44% (n=4973 individuals captured; Saracco *et al.* 2006). The time-constant recapture probability from the MAPS data pooled across all stations from 1992-2001 is 49% (Saracco *et al.* 2006). A spatial model of adult survival between 1992 and 2003 for the entire species range in North America shows that low survival generally coincides with regions experiencing severe population declines (Saracco *et al.* 2010). In southern Ontario, the apparent survival rate is among the highest in North America (0.479-0.53, n= 6241 birds captured at 179 MAPS stations from 1992-2003) while in southern Québec it is among the lowest (0.417-0.448; n= 6241 birds captured at 179 MAPS stations from 1992-2003; Saracco *et al.* 2010).

**Movements/dispersal**

Adult movements

A geolocator study by Stutchbury *et al.* (2009) revealed that individuals migrate between the breeding and the wintering grounds in Central America (typically Nicaragua and Honduras) either across or around the Gulf of Mexico (equivalent to a 4,600 km route); individuals complete their migration in 13 to 15 days at a speed of 233-271 km/day. The study also suggests that spring and fall migration routes differ; the species spring migration route is further west (following the Mississippi valley) than the fall route, which follows the Atlantic coast. During both spring and fall migration, the Gulf of Mexico could be crossed in order to reach the Yucatan Peninsula or the northern Gulf Coast.

Research on radio-tracked females in the eastern United States indicate that movement can vary from 100 m to 16 km between nesting attempts, and that most longer movements happen following nest failures (Powell *et al.* 1999). Similar results derived from five radio-tracked females in northwestern Pennsylvania showed that females moved 200-700 m from their original successful nest site (Gow 2009). In northern Virginia, adults either moved short distances to moulting sites on their territory after nesting, or moved between 545-7291 m from nesting territories (Vega Rivera *et al.* 1998). In contrast, most pairs of Wood Thrushes in a study in Delaware did not leave 15-ha woodlots during the breeding season; except after nesting failure (Evans *et al.* 2011). In southern Ontario, the average distance of a second nest from a successful early nest was 72.6 m (range 0-400 m) and half of all second nests were built within 50 m of the first nest (Friesen *et al.* 2000).

Juvenile movements

In forested landscapes in Georgia, radio-tracked fledglings dispersed from 1-6.4 km, often crossing open habitats in order to settle in dense shrubby habitat (Powell *et al.* 1999). Wood Thrush fledglings are known to remain within a 500-m radius of such places until migration (Powell *et al.* 1999). In Missouri, Georgia, and Virginia populations, most juveniles disperse 1.5-2 km from their natal home range (Anders *et al.* 1998; Vega Rivera *et al.* 1998; Lang *et al.* 2002) and they rarely remain on their natal territory (Lang *et al.* 2002). Most individuals disperse as part of juvenile flocks (Vega Rivera *et al.* 1998). A study based on movements between source and sink populations in Wood Thrush suggest that juveniles ultimately disperse between 60 and 80 km (Tittler *et al.* 2006).

**Diet and Foraging Behaviour**

The Wood Thrush forages in leaf litter or on semi-bare ground where herbaceous cover is open, and almost exclusively under the forest canopy (Willis 1966; Holmes and Robinson 1988; Evans *et al.* 2011). Prey include larval and adult insects (Coleoptera, Diptera, Hymenoptera, and Lepidoptera), millipedes, and isopods. Studies of stomach contents from Canada and the United States indicate that 62% of the material ingested is animal matter (Lepidoptera 11%, Arachnida 8%, Coleoptera 4%, and Orthoptera 2%), and 38% is vegetable matter (Weaver 1949). In New Hampshire, another study of 329 items obtained in emetic samples from 60 breeding birds showed that 33% were adult Coleoptera, mostly carabids, curculionids, and elaterids; 18% Diptera, mostly adults; 17% Hymenoptera (mostly ants); 12% Lepidoptera (mostly larvae); and 10% Chilopoda, Diplopoda, and Mollusca combined (Holmes and Robinson 1988). Prey may also include vertebrates such as small salamanders (Evans *et al.* 2011).

Post-fledgling diet is mainly composed of fruits including blueberry (*Vaccinium* spp.), American Elderberry (*Sambucus canadensis*), Jack-in-the-pulpit (*Arisaema triphyllum*), and Black Cherry (*Prunus serotina*; Evans *et al.* 2011).

## Interspecific Interactions

In southern Ontario, a miniature video camera study that filmed Wood Thrush nests over 24-hour periods from 2007 to 2010 documented the following nest predators: Cooper's Hawk (*Accipiter cooperii*), Sharp-shinned Hawk (*Accipiter striatus*), Red-tailed Hawk (*Buteo jamaicensis*), American Crow (*Corvus brachyrhynchos*), Blue Jay (*Cyanocitta cristata*), Raccoon (*Procyon lotor*), Eastern Chipmunk (*Tamias striatus*), Red Squirrel (*Tamiasciurus hudsonicus*), Eastern Grey Squirrel (*Sciurus carolinensis*), and Short-tailed Weasel (*Mustela erminea*) (L. Friesen; unpubl. data 2012). A White-footed Mouse (*Peromyscus leucopus*) was documented repeatedly attacking an incubating female Wood Thrush but was unable to break open the eggs. In this study, Brown-headed Cowbirds were also documented parasitizing nests (L. Friesen; unpubl. data 2012).

Across the species breeding range, identified predators also include Black Rat Snake (*Elaphe obsoleta*), Black Bear (*Ursus americanus*), Common Grackle (*Quiscalus quiscula*), Southern Flying Squirrel (*Glaucomys volans*), and Least Weasel (*Mustela rixosa*), (Twomey 1945; Simons and Farnsworth 1996; Farnsworth and Simons 2000; Friesen *et al.* 2007; Evans *et al.* 2011). Circumstantial evidence suggests that domestic cats (*Felis catus*) and Great Horned Owls (*Bubo virginianus*) also prey on Wood Thrushes (Paul Jr. pers. comm. in Evans *et al.* 2011). During the breeding season male Wood Thrushes may show aggression towards potential competitors, including the Hermit Thrush (*Catharus guttatus*) and the Veery (*Catharus rufescens*) (Dilger 1956; Morse 1971).

In the wintering range, predators include Ferruginous Pygmy-owl (*Glaucidium brasilianum*), Barred Forest-falcon (*Micrastur ruficollis*), and unidentified mammalian predators (Rappole *et al.* 1989).

## Home Range and Territory

Wood Thrushes show high site fidelity to breeding territories across seasons (Evans *et al.* 2011), which is more pronounced in males than females (Friesen; pers. comm. 2012). Male Wood Thrushes usually establish and defend their breeding territories, but do not usually respond agonistically to new conspecifics, models, and playbacks of songs and calls (Friesen; pers. comm. 2012). In Ontario, Freemark and Merriam (1986) estimated territory size at 2 ha. In the eastern United States, several studies report territory sizes ranging between 0.08–4.0 ha (Twomey 1945; Weaver 1949; Evans *et al.* 2011). Territories used for different nesting attempts can also vary spatially during the breeding season (Evans *et al.* 2011). In some populations, there is also considerable overlap between territorial limits (Brackbill 1943; Holmes and Robinson 1988; Evans *et al.* 2011). In Waterloo Region, male density has ranged from 0.07 to 0.55 pairs/ha, the lowest densities occurred in woodlots surrounded by houses, with the highest densities in rural woodlots without adjacent housing (Friesen; pers. comm. 2012).

Wood Thrushes also show fidelity to wintering sites (e.g., Kricher and Davis 1986; Winker *et al.* 1990; Blake and Loiselle 1992) and where individuals defend territories against conspecifics (Rappole and Warner 1980; Winker *et al.* 1990; Blake and Loiselle 1992). The mean home range of sedentary individuals in Yucatán during a single season is 0.46 ha (SD = 0.27; n = 7; 0.12–1.03; Winker *et al.* 1990).

**Behaviour and Adaptability**

The Wood Thrush is relatively tolerant of forest fragmentation as it can nest in small woodlots (Rich *et al.* 1994). However, in areas with high levels of forest fragmentation in an agricultural dominated matrix, the species is known to be less tolerant as shown by a decrease in reproductive success (Evans *et al.* 2011; see Threats and Limiting Factors). In the United States, Wood Thrushes are also less tolerant of habitat fragmented by wide linear corridors such as power line corridors (Rich *et al.* 1994).

The species is relatively tolerant of forest management activities that are conducted on a small spatial scale (i.e. single-tree, group selection cuts, uneven-age forest management, selective removal of mature trees; Crawford *et al.* 1981; Gram *et al.* 2003). In southern Ontario, Holmes *et al.* (2004) reported that Wood Thrushes were more abundant in heavily cut woodlots than in standard cut woodlots or uncut woodlots. Like some natural perturbations, high-grade logging will first alter the Wood Thrush habitat for a few years, but then will likely create suitable habitat when the understory and saplings regenerate (Friesen; pers. comm. 2012). Moreover, post-breeding adults and juveniles have been documented using clearcuts adjacent to mature forest in the eastern United States; the reason for the use of clearcuts is currently unclear but may include increased food abundance or protection from predators relative to that found in mature forest (Marshall *et al.* 2003).

In Ontario, mature stands affected by severe ice storms usually resulted in increasing understory cover that led to a higher density of Wood Thrushes (Friesen 2007). The high density of Wood Thrushes found in eastern Ontario could possibly be explained by the major ice storm of 1998, which subsequently created prime habitat for the species (Friesen, pers. comm., 2012). Holmes and Sherry (2001) reported similar patterns in the United States where Wood Thrushes remained in areas severely affected by a hurricane for the first 10-15 years, but almost disappeared from the area afterward.

## POPULATION SIZES AND TRENDS

### Sampling Effort and Methods

Breeding Bird Survey (BBS)

The BBS is a program that surveys North American breeding bird populations (Environment Canada 2010; Sauer *et al.* 2011). Breeding bird abundance data are collected by volunteers at 50 roadside stops spaced at 0.8 km intervals along permanent 39.2 km routes (Sauer *et al.* 2011). In Canada, the surveys are generally conducted in June (i.e., during the breeding period of most bird species). Surveys start one half hour before sunrise and last about 5 hours. The BBS is designed to measure population changes, but has also been used, with some important assumptions, to estimate population sizes. Data from across much of North America have been collected according to a single standardized method; survey routes have random start points within a stratified framework, thus enhancing regional representation of the avifauna (roadside bias notwithstanding) (Blancher *et al.* 2007).

The BBS is the most reliable source of data for the Wood Thrush in Canada, with good coverage of the species' breeding range in Canada (North American Bird Conservation Initiative Canada 2012). The Wood Thrush has a highly recognizable song and its occurrence in fragmented habitats means it should be detected wherever it occurs along forested BBS routes.

Since 2011, BBS population trends have been estimated using hierarchical log-linear model analyses rather than route-regression analyses, which were used previously. Compared to the latter, the hierarchical model analysis is a year to year comparison of the annual indices (Smith, pers. comm. 2012). The hierarchical model assumes there is an underlying long-term trend and departs from that trend only if there is strong evidence in the data. Trend results from hierarchical models are generally more precise than the results of the earlier analysis (Sauer and Link 2011) and less susceptible to inter-annual variation due to sampling error (Smith, pers. comm. 2012). Also, the national indices are scaled to reflect the average abundance of the species on routes in Bird Conservation Regions (BCRs)/Province-Strata where the species has been observed; this is different from the previous Canadian analysis, where indices were scaled to an average of all BBS routes run in the country (Smith, pers. comm. 2012).

Breeding Bird Atlases (BBA)

The Ontario Breeding Bird Atlas (OBBA) compares the distribution of breeding birds between 1981-1985 and 2001-2005. The data were gathered by volunteers who visited representative habitats within 10 x 10-km squares for at least 20 hours during the breeding period (Cadman *et al.* 2007). The percent change in the distribution of the Wood Thrush in Ontario over a period of 20 years is then calculated by comparing the percentage of the 10 x 10-km squares with breeding evidence in the first atlas period to the percentage of squares with breeding evidence in the second atlas period, adjusting for observation effort (Cadman *et al.* 2007). The most recent OBBA also estimated and mapped the relative abundance of birds, which is an important addition (Cadman *et al.* 2007).

An important limitation of this method is that the trend analysis from the first to the second atlas is based on changes in the probability of observing a species in a 10 X 10-km square after adjusting for effort (Blancher *et al.* 2007). This method will underestimate population change for common species (Francis *et al.* 2009) because it is based on presence and absence rather than relative abundance. Differences in effort between the two atlases may also have led to some biases in estimating change (Blancher *et al.* 2007) because non-point count effort was not standardized, and there can be important differences in efficiency of effort that cannot be captured by adjusting for quantity of effort. Another major limitation of atlases is that they are typically repeated only at 20-year intervals, which means they cannot detect changes in population status during intervening periods (Francis *et al.* 2009).

Using the same methodology as for the OBBA, data collection for a second atlas has been completed for the Maritimes (for the period 2006-2010; BSC 2012a), and initiated for Québec (2009-2012, in progress; BSC 2012c). The first atlas projects for Québec and the Maritimes were conducted between 1984 and 1989 and between 1986 and 1990, respectively (Erskine 1992; Gauthier and Aubry 1995).

Ontario Forest Bird Monitoring Program (OFBM)

The Ontario Forest Bird Monitoring Program began in Ontario in 1987 to provide information on population trends and habitat associations of birds that breed in the forest interior (OFBM 2006). Each year, between 50 and 150 sites are surveyed by volunteers, who make two 10-minute visits to five point count stations per site. Although the OFBM primarily targets 52 species, it yields data on occurrence and relative abundance for more than 100 species on those sites. The program was designed to investigate spatial and temporal patterns in mature forest-related birds, with monitoring sites selected in off-road locations in core areas of large, mature forests that are protected from active forest management. Trend analyses for the Wood Thrush are currently provided for the period 1987-2010 (OFBM 2006; R. Russell; unpubl. data 2012).

The data from these surveys cannot, however, be used to calculate population trends on a broader scale because sites have not been selected at random and the survey samples only a subset of habitats (Francis *et al.* 2009).

Long Point Bird Observatory (LPBO)

Migrants have been counted during spring and fall migration at Long Point, Ontario since 1961 and this site represents the only station in the Canadian Migration Monitoring Network where a significant number of Wood Thrushes have been sampled during migration (BSC 2011). In addition to banding, volunteers also carry out a daily census of migrating birds and keep track of all the migrants they observe throughout the day. Annual population indices for the Wood Thrush are obtained by averaging daily counts in each season, after considering the effects of date (BSC 2011).

Étude des Populations des Oiseaux du Québec (ÉPOQ)

In Québec, the ÉPOQ is a database of bird checklists submitted by thousands of volunteers since 1955 (accumulating more than 500,000 checklists) and is a primary reference for determining Wood Thrush population trends in Québec (Cyr and Larivée 1995; Larivée 2011). The ÉPOQ database covers all regions south of the 52nd parallel, especially the St. Lawrence Lowlands where the Wood Thrush is most abundant, and in all seasons (Cyr and Larivée 1995). The abundance index is one of two abundance measures produced by ÉPOQ and is a measure of the number of birds observed compared to the number of checklists submitted.

The strength of this survey lies in the fact that it covers the entire breeding range of the species in Québec (Cyr and Larivée 1995). However, the current analysis method does not take observation effort (i.e., the number of observers per checklist), weather conditions, or spatial variation in observation effort into account, but simply the number of hours of observation (Cyr and Larivée 1995). Nonetheless, the trends produced by the ÉPOQ database are generally correlated with those of the BBS and generate adequate trend assessments (Cyr and Larivée 1995; Dunn *et al.* 1996).

**Abundance**

Between 1987 and 2006, BBS data indicate that the Wood Thrush reached its highest abundance in Ontario (Lake Simcoe-Rideau, Southern Shield and Carolinian regions) and in some regions of southern Québec (Outaouais, Estrie and Québec; Figure 4).

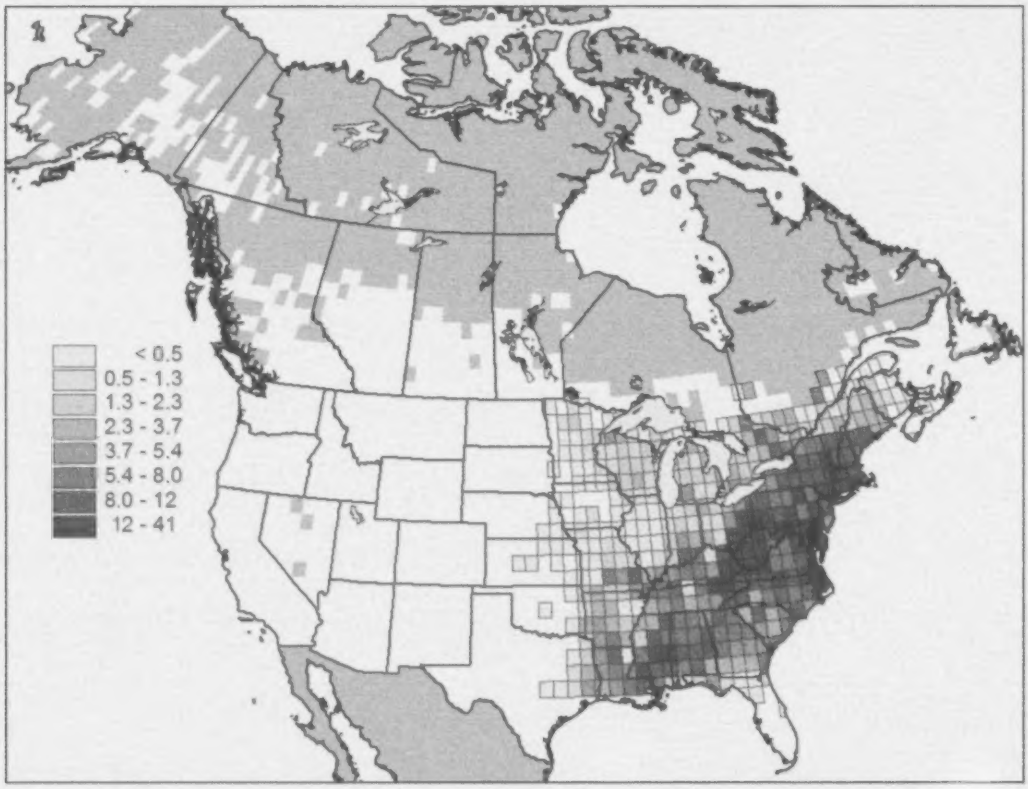


Figure 4. Relative abundance (average number of birds per route) of the Wood Thrush, based on BBS data calculated for each latitude and longitude degree block from 1987-2006, in relation to the proportion of the breeding range surveyed by the BBS. Grey areas = not surveyed by BBS, white areas = surveyed, but no Wood Thrushes observed (Environment Canada 2009).

Updating BBS-based calculations from the 1990s (Blancher *et al.* 2007), the Canadian Wood Thrush population is estimated at roughly 665,000 individuals (P. Blancher, unpubl. data 2012). The Canadian breeding population is largest in Ontario and Québec, with relatively smaller numbers in New Brunswick and Nova Scotia (Table 1).

**Table 1. Population size and relative abundance of the Wood Thrush in Canada based on North American Breeding Bird Survey data from 1998-2007 (P. Blancher, unpubl. data 2012).**

| Province / State / Territory | Population size (adults) | Percent of Canadian population | Percent of global population | Number of BBS routes | Number of routes with detection |
|---|---|---|---|---|---|
| ON | 520,000 | 78 | 4.6 | 123 | 89 |
| QC | 130,000 | 19 | 1.1 | 99 | 45 |
| NB | 16,000 | 2 | 0.1 | 31 | 7 |
| NS | 700 | > 0 | > 0 | 29 | 2 |
| **Total** | **665,000** | **100** | **5.8** | **282** | **143** |

Another population estimate for Ontario is provided by Blancher and Couturier (2007), where point count data from the OBBA (including off-road counts) gathered between 2001 and 2005 suggest a population of approximately 200,000 individuals. Extrapolation from the Ontario atlas estimate to Canada, based on the proportion of the population in Ontario (Table 1), gives an estimate of approximately 260,000 individuals in Canada. This approach likely underestimates the population size because point counts used to estimate abundance start later in the morning after birds are active, so some individuals were likely missed. The most reasonable population estimate is likely a range between the two estimates of the Canadian population i.e., between 260,000 and 665,000.

**Fluctuations and Trends**

For Québec, Ouellet (1974) compared historical records of the Wood Thrush in the Montréal and Montérégie regions in southern Québec and suggested that the species had probably increased from the beginning of the 1800s until the 1970s. The population in Ontario has also apparently increased from the early 1900s to the 1980s according to historical records (Cadman *et al.* 1987). In the Maritime provinces, the Wood Thrush was considered an increasing and a regular nesting species in New Brunswick (Erskine 1992), but in Nova Scotia it was considered a rare vagrant before the 1970s (Tufts 1986). The historical trend is similar in the northeastern US (Weaver 1949; Morse 1971; Robbins 1991).

Breeding Bird Survey (BBS)

Long-term BBS data show a significant annual rate of decline of 4.29% (95% credible interval (CI): -5.06, -3.55) between 1970 and 2011 (Figure 5, Table 2; Environment Canada unpubl. data 2012). At this rate, the population will have decreased by approximately 83% over the last 41 years. Data from the most recent 10-year period (2001 - 2011) show a significant decline of 4.69% per year (95% CI: -6.73, -2.84; Figure 5, Table 2; Environment Canada unpubl. data 2012), which amounts to a loss of 38% of the population over the last 10 years or approximately three generations. The probability that there is at least a 30% decline in abundance over this time period is 89%.

Trends estimated for each province indicate that the Wood Thrush is also showing significant long- and short-term declines in Ontario, Québec and New Brunswick (Table 2). Population losses over the last 10 years range from 54% for New Brunswick to 36% for Ontario.

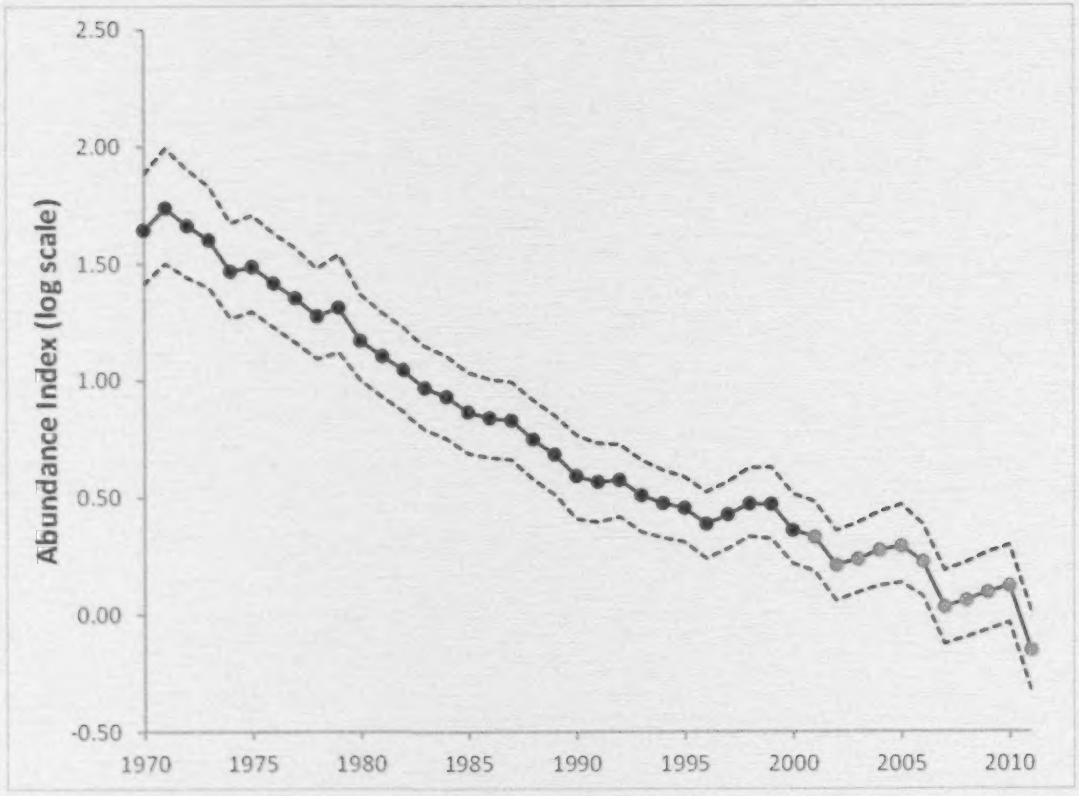


Figure 5. Annual rate of change for the Wood Thrush in Canada between 1970 and 2011 based on a hierarchical Bayesian model of Breeding Bird Survey data (Environment Canada unpubl. data 2012). Dotted lines correspond to the upper and lower credible intervals. The trend for the last 10 years is highlighted in red.

**Table 2. Long- and short-term annual population trends for the Wood Thrush based on BBS surveys (Environment Canada unpubl. data 2012), with 95% lower (LCI) and upper (UCI) credible intervals. Results in bold are statistically significant declines, i.e., 95% credible intervals do not overlap zero.**

| | 1970-2011 | | | 2000-2011 | | |
|---|---|---|---|---|---|---|
| **Region** | **Annual Rate of Change** | **LCL** | **UCL** | **Annual Rate of Change** | **LCL** | **UCL** |
| Canada | **-4.29** | -5.06 | -3.55 | **-4.69** | -6.73 | -2.84 |
| Ontario | **-2.95** | -4.00 | -1.90 | **-4.02** | -6.55 | -1.72 |
| Québec | **-6.68** | -7.86 | -5.41 | **-7.02** | -9.63 | -4.97 |
| New Brunswick | **-7.08** | -8.76 | -5.42 | **-7.44** | -11.74 | -4.16 |

## Étude des Populations des Oiseaux du Québec (ÉPOQ)

The ÉPOQ database shows a significant long-term decline in Wood Thrush abundance in Québec of 0.7% per year ($R^2$= 0.56, P ≤ 0.05; Figure 6) between 1970 and 2009, representing a 24% loss in the population over 40 years. In the most recent 9-year period (2000-2009), the data show a non-significant decline of 0.3% per year ($R^2$=0.14, P ≥ 0.05).

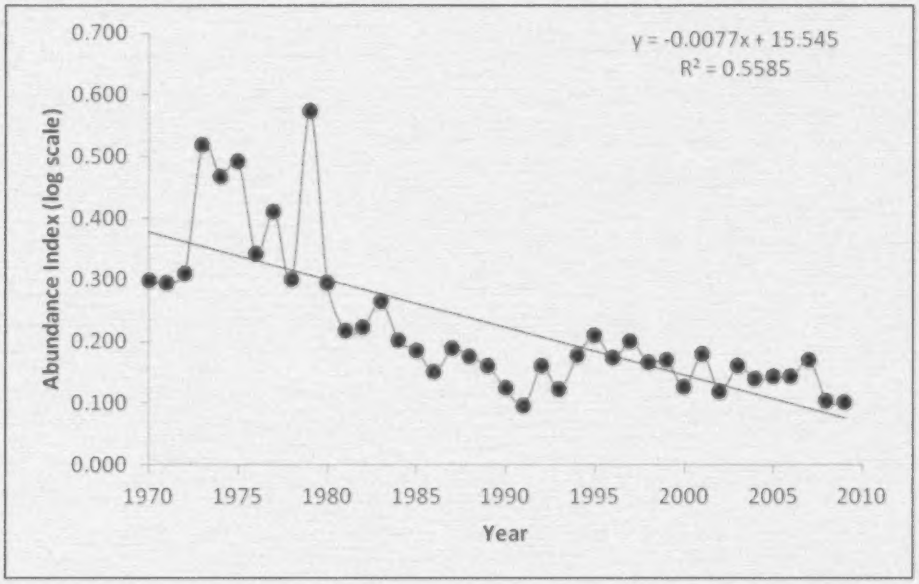


Figure 6. Annual indices of population change for the Wood Thrush in Québec between 1970 and 2009, based on a linear regression of the ÉPOQ data (Larivée 2011). Only checklists produced during the known breeding period (15 May to 15 July) were used in the analysis.

## Breeding Bird Atlases

### *Ontario Breeding Bird Atlas (OBBA)*

A comparison of the species probability of observation in Ontario from the first (1981-1985) to the second (2001-2005) atlas period showed an overall non-significant decline of 7% across the province as a whole, with a significant decline of 15% in the Southern Shield, a non-significant decline of 3% in the Carolinian region and a decline of 1% in the Lake Simcoe-Rideau region (Friesen 2007; Figure 7).

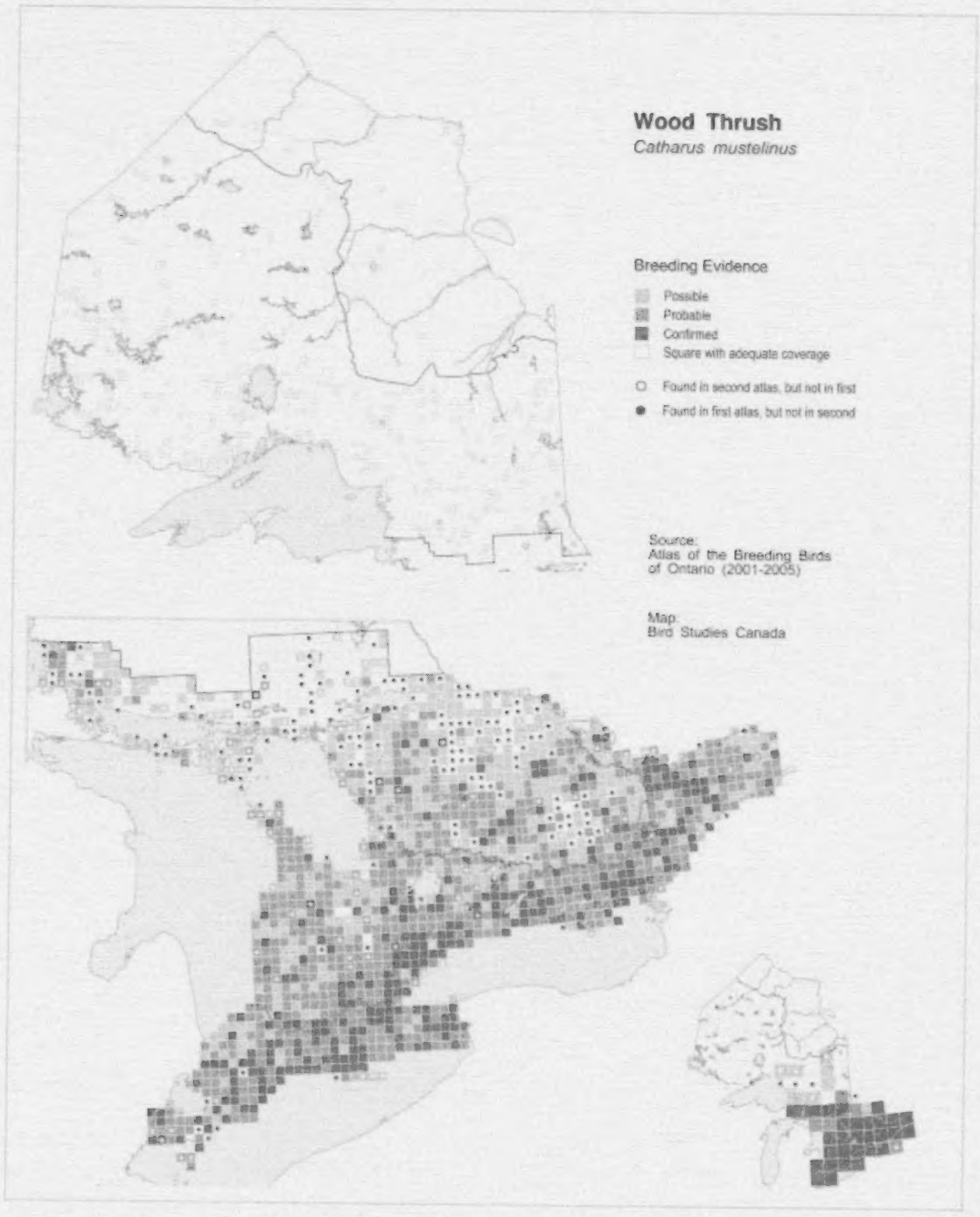


Figure 7. Ontario distribution of the Wood Thrush during the period 2001-2005, based on atlas data (reproduced with permission from Cadman *et al.* 2007). Squares with black dots are those in which the species was found in the first atlas period (1980-1985), but not in the second (2001-2005). Squares with yellow dots are those in which the species was found in the second atlas period but not in the first.

*Maritime Breeding Bird Atlas (MBBA)*

Preliminary analyses for the Maritime Breeding Bird Atlas indicate a significant decrease in the probability of observation for the Wood Thrush between the first (1986-1990) and second (2006-2010) atlas periods, with the probability of observation dropping from 0.45 to 0.09 over this period (M. Campbell, BSC, unpubl. data 2012). The change in probability is equivalent to an 80% decrease in the population over the 20 years between the two atlas periods or a 55% loss over a 10-year period. The decline was stronger in New Brunswick (8.9% annual decline) than Nova Scotia (3.1% annual decline) (M. Campbell, BSC, unpubl. data 2012). Comparison of the species distribution between the two atlas periods suggests that remaining Wood Thrushes are scattered throughout the earlier range, i.e., there has been a reduction in occupancy but probably no range retraction (Figure 8).

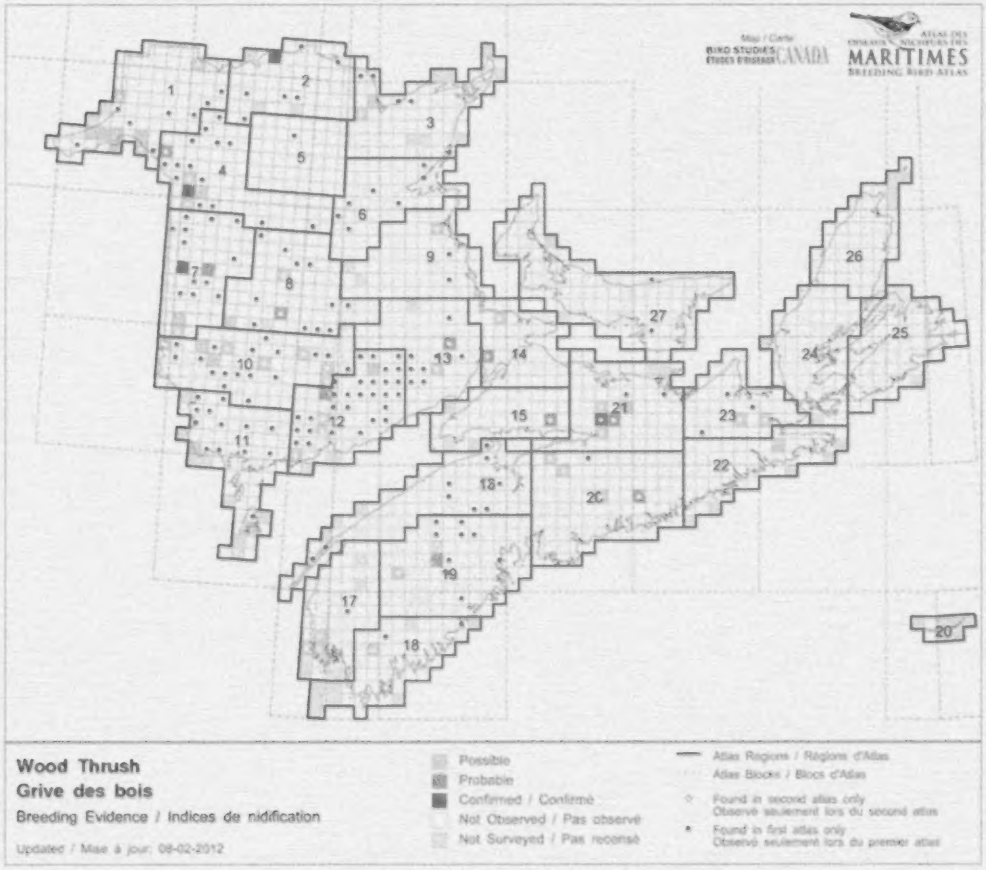
MARITIMES
Wood Thrush
Grive des bois
Breeding Evidence / Indices de nidification
Updated / Mise à jour: 09-02-2012
Possible
Probable
Confirmed / Confirmé
Not Observed / Pas observé
Not Surveyed / Pas recensé
Atlas Regions / Régions d'Atlas
Atlas Blocks / Blocs d'Atlas
Found in second atlas only
Observé seulement lors du second atlas
Found in first atlas only
Observé seulement lors du premier atlas

Figure 8. Distribution of the Wood Thrush in the Maritimes during the period 2006-2010 (reproduced with permission from BSC 2012a). Squares with black dots are those in which the species was found in the first atlas period (1986-1990), but not in the second (2006-2010). Squares with yellow dots are those in which the species was found in the second atlas period but not in the first.

*Québec Breeding Bird Atlas (QBBA)*

Preliminary analyses based on the first two years of the second QBBA suggest that the probability of observing a Wood Thrush in atlas squares with at least 20 hours of observation in both the first and second atlas periods has declined by 28% over the 20 year period (n=317 atlas squares; Atlas des oiseaux nicheurs du Québec 2012).

*Ontario Forest Bird Monitoring Program (OFBM)*

The results from the OFBM program show a non-significant decline of -1.6 % per year (n=153 sites; P>0.05; LCI= -7.0, UCI= 4.1) in mature forest sites in Ontario between 1987 and 2010 (R. Russell, unpubl. data 2011).

*Long Point Bird Observatory (LPBO)*

Data from LPBO for the 1970 - 2010 and 2000 - 2010 periods indicate non-significant population trends during spring and fall migration (Crewe pers. comm. 2012).

**Population Trend Summary**

The results of the BBS, which is the most reliable source of population trend information for Wood Thrush in Canada, show significant long- and short-term population declines for the Wood Thrush in Canada. This general pattern is consistent for each of the provinces where the species occurs, but with more severe declines occurring in Québec and New Brunswick than in Ontario.

**Rescue Effect**

Recent evidence indicates that juvenile Wood Thrush disperse between 60 and 80 km from their natal sites (Tittler *et al.* 2010), suggesting that rescue of the Canadian population from the US is feasible. However, Wood Thrush numbers in the US show significant declines (long-term trend: 1966-2010: -1.8% per year; n= 1879 routes, 95% C.I.: -2.0, -1.6; short-term trend: 1999-2010: -1.9% per year, n= 1879 routes, 95% C.I.: -2.4, -1.5 Sauer *et al.* 2011; Figure 9), which reduces the potential for rescue. In addition, many states bordering Canada (e.g. Pennsylvania, New York, Vermont, New Hampshire, Maine) showed significant declines between 2000 and 2010 (Sauer *et al.* 2011). Although, more central states have shown either increases (Michigan) or stability (Ohio) (Figure 9), these states have relatively low Wood Thrush abundances (Figure 4), which also reduces the potential for rescue in Canada.

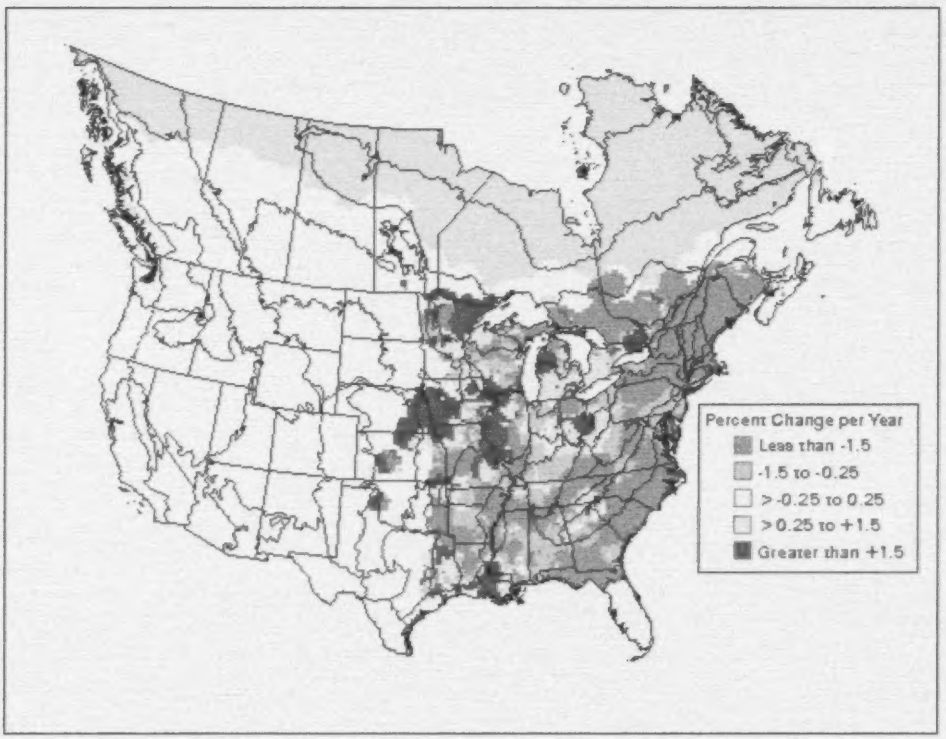


Figure 9. BBS trend map for Wood Thrush in the United States and Canada for the period from 1966 to 2010 (Sauer *et al.* 2011).

## THREATS AND LIMITING FACTORS

### Habitat Fragmentation and Loss

Breeding grounds

The response of Wood Thrushes to habitat fragmentation varies spatially in North America and may depend on the type of perturbation (Evans *et al.* 2011). In the highly fragmented landscapes dominated by the intensive agriculture of the northeastern United States, for example, Wood Thrushes appear to be sensitive to habitat fragmentation (Hoover *et al.* 1995; Trine 1998; Rosenberg *et al.* 2003). In those landscapes, the species is generally more abundant and shows higher nesting success in larger forest patches compared with smaller ones (Whitcomb *et al.* 1981; Hoover 1992). High rates of nest predation in small forest tracts (less than 80 ha) as well as high rates of cowbird parasitism (see below for more details on these related threats) explained the lower nesting success in highly fragmented landscapes (Hoover *et al.* 1995; Rosenberg *et al.* 2003).

In southern Ontario, however, the negative effect of habitat fragmentation appears to be weak (Friesen *et al.* 1999). For example, in a landscape that was only 14% forested, Wood Thrush breeding populations in forest tracts 3-140 ha in size were considered to be self-sustaining (Friesen *et al.* 1999). Neither forest size nor distance to the edge of the forest significantly affected nesting success (Friesen *et al.* 1999). In southern Québec, Wood Thrushes breed in fragmented landscapes but prefer clustered woodlots within a radius of 5 km (Carignan 2006).

Wintering grounds

On the wintering grounds, Wood Thrushes are relatively tolerant of forest fragmentation as the species is known to use forest patches several orders of magnitude smaller than what is necessary for breeding Wood Thrushes in temperate areas (i.e. ≥ 1 ha in size; Roberts 2011). Nonetheless, forest habitat in Central America is declining at a high rate (see Habitat Trends section), thus overall habitat loss may pose a relatively greater threat than habitat fragmentation on the wintering grounds.

**Habitat Degradation**

Over-browsing by White-tailed Deer

Over-browsing by the White-tailed Deer (*Odocoileus virginianus*) is known to drastically change the structure of the deciduous and mixed forests in eastern North America by decreasing plant and tree diversity and abundance and reducing saplings (Collard *et al.* 2010; Tanentzap *et al.* 2011), which is the prime nesting habitat for Wood Thrushes. These changes in the structure of the forests are also known to negatively affect abundance of ground- and shrub-nesting songbirds (DeGraaf *et al.* 1991; McShea *et al.* 1995) by reducing the nesting cover or by reducing the density and diversity of insects. Overall bird species richness and intermediate canopy nesting species are also known to decline up to 27% due to over-browsing and several species are absent from sites with deer densities > 8 deer/km$^2$ in the eastern United States (deCalesta 1994). Under deer densities ranging from 7-16 deer/km$^2$ in southern Québec, over-browsing significantly reduced the density of the shrub layer in canopy gaps (Collard *et al.* 2010). In Rondeau Provincial Park in southern Ontario, despite significant and sustained deer herd reductions between 1996 and 2009 (deer densities were reduced from 55 to 7 deer km$^2$), there was limited recruitment of small trees and declines in basal area of tree species that were sensitive to deer browsing (Tanentzap *et al.* 2011). In this park, Wood Thrush numbers were observed to be very low when forest bird monitoring was initiated in the early 1990s, but then responded to a modest increase in understory regeneration following deer control efforts. More studies are needed to examine the impact of deer-browsing on Wood Thrush in other parts of its range.

Residential development

Although the Wood Thrush will breed in urban contexts if the proportion of forest within a 5 km radius is high (Carignan 2006), residential development has been shown in many studies to negatively affect Wood Thrushes (Friesen *et al.* 1995; Suarez-Rubio *et al.* 2011; L. Friesen, unpubl. data 2012). For example, in southern Ontario, as the number of houses surrounding forest patches increased, the number of breeding Wood Thrushes decreased markedly (Friesen *et al.* 1995). This effect was independent of the size of the forest tracts, which ranged in size from 3-50 ha (Friesen *et al.* 1995). This study also showed that nesting success and nest productivity were similar in urban and rural woodlots, suggesting that the factors affecting reproductive success (e.g. increased numbers and types of predators, roads, etc.) were similar in urban and rural woodlots.

An ongoing study is documenting the response of Wood Thrush in a 120 ha forest next to a residential development that has increased from several houses in 1998 to over 3000 houses in 2011. The results of the study show that the number of females, nests, and fledglings is significantly lower in urban forest sites compared to rural control sites (L. Friesen, unpubl. data 2012). Point count data also show that in the urban forest (n=18 stations) Wood Thrushes declined from an average of 1.6 male per point count to 0.05 male per point count from 1998 to 2011, whereas densities of males in rural controls were significantly higher during the same period (L. Friesen, unpubl. data 2012). The reasons for the decline in occupancy in the urban area are unknown (Friesen, pers. comm. 2012), but could include increasing densities of nest predators such as Raccoons, corvids and cats around residential areas, as well as noise, the cumulative effects of fragmentation, roads, and development.

**Predation**

In the United States, Wood Thrush nesting success is negatively correlated with predation rate, which increases with the degree of forest fragmentation (Hoover *et al.* 1995). In Canada, nest predation is also considered a primary threat to the Wood Thrush and seems highly related to the degree of habitat fragmentation (Friesen *et al.* 1999, 2005). In southern Ontario, Friesen *et al.* (2005) reported on a study of 239 Wood Thrush nests showing nesting success levels of 51% and 47% in rural woodlots and an urban woodlot, respectively, due principally to nest predation. High nest predation rates are also reported for northern Indiana (58%; Fauth 2000), Illinois (50-80%; Trine 1998), northwest Pennsylvania (74%; Gow 2009) and Delaware (71%; Evans *et al.* 2011). In Pennsylvania, Wood Thrush nesting success is reported to be 86% in contiguous forest (> 10,000 ha), 72% in forest fragments larger than 100 ha, and 43% in small fragments of less than 80 ha (Hoover *et al.* 1995).

**Brown-headed Cowbird Parasitism and Predation**

The parasitism rate on Wood Thrushes varies geographically and temporally (Evans *et al.* 2011; L. Friesen; unpubl. data 2012), but it is generally considered an important threat. In Canada, the parasitism rate is relatively high with values ranging between 11% and 60% in various studies conducted in Ontario (Peck and James 1987; Friesen *et al.* 1999; Phillips *et al.* 2005; L. Friesen; unpubl. data 2012). In southern Ontario, the overall parasitism rate for all nests during the study period of 1998-2010 was 33%, with parasitized nests containing an average of 1.4 cowbird eggs (L. Friesen; unpubl. data 2012).

In Ontario, rates of brood parasitism increase significantly when houses are embedded in woodlots (Philips *et al.* 2005) and in highly fragmented forest landscapes (Burke and Nol 2000). In fragmented landscapes, parasitism may reduce annual fledgling production to the extent that it threatens population stability (Evans *et al.* 2011). In the Waterloo Region, parasitism rates did not differ significantly between rural woodlots and an urban forest (Friesen *et al.* 2005; L. Friesen; unpubl. data 2012). In this area, the threat caused by cowbirds seems to vary geographically and over time (L. Friesen; unpubl. data 2012). Moreover, despite the fact that the Waterloo Region is a highly fragmented landscape, parasitism rates of Wood Thrush nests are lower than in similar landscapes in the US Midwest where parasitism rates range from <10% to 100% (Hoover and Brittingham 1993; Donovan *et al.* 1995; Robinson *et al.* 1995; Hoover *et al.* 1995; Trine 1998; Evans *et al.* 2011).

Friesen *et al.* (2007) reported that cowbirds frequently removed Wood Thrush eggs from nests, and cowbirds were also filmed eating eggs.

**Other Threats**

Additional threats that could impact eastern forest songbirds including Wood Thrushes but that need further research include: forest degradation due to beech bark disease as it impacts one of the primary nest trees of the Wood Thrush (Griffin *et al.* 2003; Evans *et al.* 2011), and large-scale afforestation resulting in large tracts of homogeneous deciduous forest with little broken canopy and a reduced shrub layer (Friesen pers. comm. 2012).

Hames *et al.* (2002) showed a strong negative effect of acid rain on the predicted probability of breeding by Wood Thrushes in the northeastern United States. Their results suggest an important role for acid rain in recent declines of Wood Thrushes in the eastern United States, particularly in high elevation zones with low pH soils, and in fragmented landscapes. Similar studies are needed in eastern Canada and the southern shield regions of Ontario, where the species decline is more pronounced and where critical load exceedances (Environment Canada 2004) indicate increased susceptibility to acid deposition.

Exotic earthworms in forested ecosystems of southern Canada may also be another threat to Wood Thrush foraging and nesting habitat as earthworms are known to substantially reduce the amount of leaf litter (Wironen and Moore 2006) and possibly reduce the abundance of arthropods, on which thrushes feed (Loss and Blair 2011). Substantial reductions in litter depth in Wood Thrush habitat could also negatively affect nesting cover and reduce nest survival as a recent study conducted in Wisconsin had demonstrated from two ground-dwelling songbird species (including the Hermit Thrush, a species with similar foraging habits to the Wood Thrush; Loss and Blair 2011).

Severe spring storms can kill migrants over the Gulf of Mexico including Wood Thrushes (Wiedenfeld and Wiedenfeld 1995). The severity of autumn storms may also affect the abundance of Neotropical migrants including Wood Thrushes (Butler 2000). Other processes acting during the nonbreeding season have been suggested to cause significant mortality in long-distance migratory birds (Sillett and Holmes 2002). For example, El Niño events in Costa Rica can negatively affect frugivorous migrants such as Swainson's Thrushes (*Catharus ustulatus*), a close relative of Wood Thrushes, which exhibit poorer condition during spring migration (Wolfe and Ralph 2009). Given synchronous responses of fruiting plants to heavy precipitation in Central America, more frequent El Niño-induced dry periods may reduce fruit abundance on a large scale, which in turn may negatively affect refuelling rates of frugivorous migrants (Wolfe and Ralph 2009). More data are needed on the effects of adverse winter weather on migrating birds (Winker *et al.* 1990) and especially the Wood Thrush.

To summarize, threats to Wood Thrushes in Canada are numerous but are currently not well understood. Threats are known mainly from southern Ontario where the species has been studied. There, habitat fragmentation is an important threat to the Wood Thrush population in the core of the breeding range. High rates of nest predation and parasitism, which are also closely linked to habitat fragmentation, are also known to negatively affect populations of breeding Wood Thrushes. Overall, more studies are needed to assess the importance of these threats and limiting factors, including in Québec and in New Brunswick. Finally, more studies are needed on threats on the wintering range.

## PROTECTION, STATUS, AND RANKS

### Legal Protection and Status

In Canada, the Wood Thrush and its nest and eggs are protected under the *Migratory Birds Convention Act*. In Québec, it is also protected under the *Loi sur la conservation et la mise en valeur de la faune* (L.R.Q., c. C-61.1), and it is prohibited to hunt, capture, keep in captivity, sell this species or destroy or damage its nest and eggs.

## Non-Legal Status and Ranks

At the global level, the species is considered secure (G5, last assessed in 2000; Table 3) by NatureServe (2012). The species is considered 'Least concern' according to the IUCN Red List (NatureServe 2012). However, the Wood Thrush is considered a "WatchList" species by the North American Landbird Conservation Plan (Rich *et al.* 2004). The species was also included on Audubon's 2007 WatchList and the State of the Birds (National Audubon Society 2012) identified Wood Thrush as one of the eastern forest birds experiencing "consistent and troubling declines". In the United States, the species is considered secure (N5; Table 3). At the state level, it is considered imperiled (S2) in one state and vulnerable in four states (NatureServe 2012).

Ranks based on NatureServe (2012) and General Status Ranks (CESCC 2011) are listed in Table 3. The species is currently not monitored by biodiversity information centres in Ontario, Québec or the Maritimes.

**Table 3. Ranks assigned to the Wood Thrush in North America, based on NatureServe (2012) and General Status Ranks (CESCC 2011).**

| Region | Rank* | General Status** |
|---|---|---|
| Global | G5 | --- |
| United States | N5B | --- |
| Canada | N4B | Secure |
| Ontario | S4B | Secure |
| Québec | S3S4 | Secure |
| New Brunswick | S1S2B | May be at risk |
| Nova Scotia | S1B | Undetermined |

* G = is a global status rank; S = rank assigned to a province or state; N= is a national status rank; B= Breeding. S1 indicates that a species is critically imperiled making it especially vulnerable to extirpation; S2 indicates that a species is imperiled making it very vulnerable to extirpation; S3 indicates that a species is vulnerable at the subnational level making it vulnerable to extirpation; S4 indicates a species is apparently secure; S5 indicates that a species is secure.

** May be at risk: Species that may be at risk of extirpation or extinction and are therefore candidates for a detailed risk assessment by COSEWIC, or provincial or territorial equivalents. Secure: Species that are not believed to belong in the categories *Extirpated*, *Extinct*, *At Risk*, *May Be At Risk*, *Sensitive*, *Accidental* or *Exotic*. This category includes some species that show a trend of decline in numbers in Canada but remain relatively widespread or abundant. Undetermined: Species for which insufficient data, information, or knowledge is available with which to reliably evaluate their general status

## Habitat Protection and Ownership

Private lands

In Canada, the vast majority (> 75 %) of the area occupied by the Wood Thrush is located on private forested land, which is for the most part unprotected. A small portion of the species breeding range on private lands is currently protected through voluntary conservation and stewardship programs across eastern Canada (Nature Conservancy 2012). Wood Thrushes breeding on private lands are also protected under the *Migratory Birds Convention Act*.

Public lands

Little information is available on the quantity of available habitat and the level of habitat protection on public lands in eastern Canada, but it undoubtedly constitutes a relatively small portion of the area occupied by this species (ca. 25 %). Relatively small portions of the deciduous and mixed forests in southeastern Canada located on public lands are protected in national and provincial parks, migratory bird sanctuaries and national wildlife areas. According to the Parks Canada's Biotics database, the Wood Thrush is present in 10 national parks (confirmed breeding in 3 parks only) and in one national historic site managed by Parks Canada (Parks Canada 2011). Moreover, the species is reported on 13 Department of National Defence establishments in eastern Canada where it is believed to be a common breeder (D. Nernberg, unpubl. data 2011).

## ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

The report writer wishes to thank Peter Blancher, Alain Filion, Jacques Larivée, Rich Russell, and Lyle Friesen for providing unpublished data on abundance, habitat and systematics. Funding for this report was provided by the Canadian Wildlife Service of Environment Canada.

The following list includes only those persons who contributed substantially to improve earlier drafts of this report. However, the report writer also wishes to thank all those who provided input, including the Conservation Data Centres, Natural Heritage Information Centres and Parks Canada Agency, as well as representatives of the provinces.

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